LOCATION SYSTEM AND METHOD WITH ACQUISITION OF ACCURATE LOCATION PARAMETERS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is related to commonly assigned United States Patent Applications:

"Multibeam Position Ambiguity Resolution", by Keith Olds, Attorney Docket Number IRI03065;

"Position Ambiguity Resolution", by Stanley Attwood, Attorney Docket Number IRI03048;

"Geolocation Responsive Radio Telecommunication System and Method Therefor", by Kristine Maine, Keith Olds, and Gerald Davieau, Attorney Docket Number IRI03052; and

"Radio Telecommunications System and Method with Adaptive Convergence Location Determination", by Keith Olds and Kristine Maine, Attorney Docket Number IRI03049;

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to systems that determine the locations of locatable units. More specifically, the present invention relates to non-coherent communication systems which determine the Doppler and/or propagation delay of signals transmitted between locator and locatable units for use as location parameters.

BACKGROUND OF THE INVENTION

A need exists for a substantially global radio telecommunications system that can provide communication services to substantially any point on or near the surface of the earth. For such a system to achieve widespread acceptance, it should be capable of operating with portable subscriber units. In order for subscriber units to have acceptable portability, they should be capable of low power battery operation, and they should be capable of transmitting and receiving electromagnetic signals through a relatively small antenna.

Such a global radio telecommunications system and other radio telecommunications systems may desire to know the locations of the subscriber units. A radio telecommunications system may then qualify the communication services offered to subscriber units depending upon subscriber unit locations. For example, services may be denied within geopolitical jurisdictions where the system has not received permission to operate from governmental licensing agencies. Moreover, the system may be responsible for billing in connection with the use of communication services, and the rates charged for such services may vary from location to location due to tariffs and the like. Likewise, different portions of the electromagnetic spectrum may be used for communications depending upon where a subscriber unit is located. Accordingly, it would be desirable to configure the system so that the locations of subscriber units may be determined and so that information describing locations may be transmitted to controllers which are responsible for making decisions regarding the granting or denying of communication services, billing rates, and the like.

Many prior art location determination systems are known, such as Global Positioning System (GPS), GLONASS, Loran, and the like. While subscriber units could be configured to incorporate components which take advantage of such location determination systems, these components would substantially increase costs of the subscriber units. Moreover, relying on such known location determination systems could reduce reliability of the radio telecommunications system by introducing reliance upon an external system.

The techniques used by such prior art systems to determine location could potentially be incorporated into a radio telecommunications system, but the introduction of such techniques could seriously degrade communication services. For example, most prior art location systems require the use of two or more transmitters or receivers ("locators") that are located at distant positions and that are capable of transmitting or receiving signals to or from a locatable unit whose location is to be determined. Furthermore, some prior art location systems require the use of coherent transceiver designs.

The requirement for two or more locators to be within view over the entire globe makes this approach economically undesirable. While this requirement might be met by placing satellite locators in high or geosynchronous orbits around the earth, higher orbits place satellites further away from locatable subscriber units on the earth. This larger distance causes the subscriber units to consume excessive power or incorporate massive antennas just to participate in communication services. Moreover, higher orbits require increased spectrum allocation to carry a given amount of communications because the allocated spectrum may be reused less frequently in a given area.

The requirement for a coherent transceiver design is also economically undesirable. Unless satellite locators orbit the earth in very high orbits, such satellite locators move relative to a point on the surface of the earth. Unless locators are substantially motionless relative to locatable units, significant amounts of Doppler are present. This Doppler constantly changes. Likewise, signal propagation delay between the satellites and subscriber units constantly changes. A coherent transceiver design which operates in spite of these extreme and changing signal parameters is undesirably complex and experiences an undesirably low reliability and undesirably high manufacturing and sales costs.

SUMMARY OF THE INVENTION

Accordingly, it is an advantage of the present invention that an improved location system and method is provided.

Another advantage of the present invention is that a location system and method are provided which are compatible with the needs of a communications system.

Another advantage of the present invention is that a location system and method are provided which may be adapted for use by satellite locators in low earth orbits.

Another advantage is that the present invention determines a position of a locatable unit using Doppler and/or propagation duration parameters of electromagnetic signals traveling between a locator unit and the locatable unit.

Another advantage is that the present invention acquires relatively accurate Doppler and/or propagation duration estimates without the use of coherent transceiver designs.

The above and other advantages of the present invention are carried out in one form by a method of locating a locatable unit using a locator unit which moves relative to the locatable unit. The method calls for transmitting a first signal from a first one of the locator and locatable units. This first signal is then received at a second one of the locator and